§21. Resistivities of Metal-Powder-Loaded Graphites for Oxidation in Air at High Temperatures -III

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In order to investigate the resistivities of graphite for oxidation, we measured the weight loss of 6 different types of graphite (isotropic graphite : IG-1T, isotropic graphite: IG-2R, highly graphitized isotropic graphite: IG-3Q, electrical high resistivity isotropic graphite: IG-4U, high density graphite : IG-5S, and ultra high density isotropic graphite: IG-6P) exposed in air at 650 ℃ for 3 hours. Also we studied chemical resistivities for 7 chemical reagent grade alloy-powders of Koval (CoNiFe), Cupro-nickel (CuNi), Nickel silver (CuNiZn), Brass (CuZn), Lead brass (CuZnPb), Bronze (CuSn), and Lead bronze (CuSnPb). The symbol in the parenthesis represents the main elements in each alloy and is also used as code in the following. The test pieces, cut from a single lot block having the size of 20mm × 10mm × 60 mm with a hole of 15 mm in diameter × 5 mm in depth for mounting metal powder, were checked for appearance, weight change, size, density, and SEM picture before and after being heated.

The measured weight losses of pure graphite are found to be 2.7% for IG-1T, 6.0% for IG-2R, and 7.2% for IG-3Q and the others show 10% or more at 650 ℃.

Fig. 1 shows three types of weight losses.
In type 1 (IG-1T), the weight loss at 650 ℃ is 1% or less with the alloy powders, except for CuZnPb and CuSnPb. Pb-containing alloys show the largest weight losses of a graphite sample. The small weight loss of IG-1T for all alloy powders suggests that alloys do not play any role for oxidation. In type 2 (IG-2R, IG-3Q, and IG-4U), the weight loss decreases when the alloy-powder is loaded, except for CuZnPb and CuSnPb. These results suggest that, at 650 ℃, some alloy powder may block air diffusion into graphite pieces which in turn decreases apparent weight loss. Type 3 (IG-5S and IG-6P), show the largest weight losses with CuZnPb and CuSnPb, but the other alloys show complex results. These results are similar to the results reported[1] on metal powders. The hole volume changes between samples with and without alloy powder were estimated by size measurements and the results are summarized in Fig. 2. Generally, the Pb-containing alloys greatly oxidize graphite: CuSnPb is the most, CuZnPb next and the others only small changes. These results suggest that lead would carry oxygen from the air to graphite, and the volume of oxygen is almost constant in alloys. The present results of the weight loss measurements of various graphites can be summarized as follows:

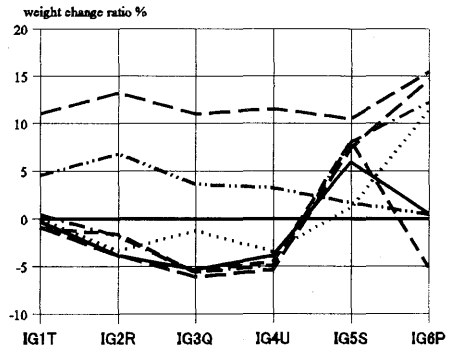
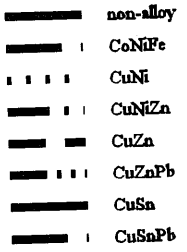


Fig. 1. Weight change ratio(%) of graphite materials with and without alloy heated at 650 ℃ in air for 3 hrs. Abscissa:code of alloy.

1) Apparent weight loss does not show a clear relationship between alloy powders and graphite materials.
2) Pb- containing alloys greatly oxidize graphite materials at their contact surface.
3) Volume changes of alloy-loaded holes represent the direct interaction strength of alloys and graphite.



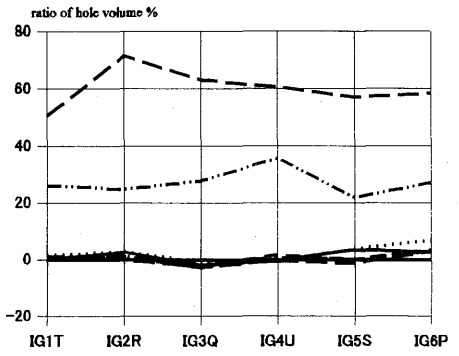


Fig. 2. Hole volume changes (%) of graphite materials with alloys heated at 650 ℃ in air for 3 hrs. Abscissa:code of alloy.

These results were presented at symposium in Tokyo[2] and at conference in Strasbourg[3].

References

1) NIFS annual report (1998) p.80.
2)Nakayama, Y., Ueda, S., and Hirano, H., Internationl Symposium on Carbon, Tokyo, Japan, 11/1998, pp.443-444
3)Nakayama, Y., Kitamura, T., Hirano, H.,and Hosokawa, K., Carbon '98, Strasbourg, France, 7/1998, pp.638-639.